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Bureaucratic Delegation and Political Institutions

When Are Independent Central Banks Irrelevant?

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Does delegation of policymaking authority to independent agencies improve policy outcomes? This paper reports new theory and tests related to delegation of monetary policy to an independent central bank. The authors find that delegation reduces inflation only under specific institutional and political conditions.

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Summary findings

The government's ability to credibly commit to policy announcements is critical to the successful implementation of economic policies as diverse as capital taxation and utilities regulation. One frequently advocated means of signaling credible commitment is to delegate authority to an agency that will not have an incentive to opportunistically change policies once the private sector has taken such steps as signing wage contracts or making irreversible investments.

Delegating authority is suggested as a government strategy particularly for monetary policy. And existing work on the independence of central banks generally assumes that government decisions to delegate are irrevocable. But delegation — in monetary policy as elsewhere — is inevitably a political choice, and can be reversed, contend Keefer and Stasavage.

They develop a model of monetary policy that relaxes the assumption that monetary delegation is irreversible. Among the testable predictions of the model are these:

- The presence of an independent central bank should reduce inflation only in the presence of political checks and balances. This effect should be evident in both developing and industrial countries.
- Political actions to interfere with the central bank should be more apparent when there are few checks and balances.
- The effects of checks and balances should be more marked when political decisionmakers are more polarized.

The authors test these predictions and find extensive empirical evidence to support each of the observable implications of their model: Central banks are associated with better inflation outcomes in the presence of checks and balances. The turnover of central bank governors is reduced when governors have tenure protections supported by political checks and balances. And the effect of checks and balances is enhanced in more polarized political environments.

This paper — a product of Regulation and Competition Policy, Development Research Group — is part of a larger effort in the group to identify the conditions under which regulatory reforms can be effective. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Paulina Sintim-Aboagye, room MC3-422, telephone 202-473-7644, fax 202-522-1155, email address psintimaboagye@worldbank.org. Policy Research Working Papers are also posted on the Web at www.worldbank.org/research/workingpapers. The authors may be contacted at pkkefer@worldbank.org or d.stasavage@lse.ac.uk. June 2000. (48 pages)

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**Bureaucratic Delegation and Political Institutions:
When are Independent Central Banks Irrelevant?**

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1. Introduction

The delegation of decision making by political actors to independent agencies has been the subject of great debate and analysis in both political science and economics (see, for example, Epstein and O'Halloran (1999), Laffont and Tirole (1990), and McCubbins, Noll and Weingast (1987). One question continues to be key to this debate: to what extent does delegation to an independent agency (or judiciary) lead to policy outcomes different than those that political actors would otherwise have adopted? This paper is concerned with one important variant of this question, the extent to which delegation makes policy announcements more credible to private actors than policy announcements made in the absence of delegation. That is, are private actors more likely to make fixed investments or subscribe to long term contracts when policy making has been delegated to an independent agency?

Although the answer to this question has implications for economic policy in areas ranging from capital taxation and utilities regulation to antitrust regulation, a natural arena to investigate it is monetary policy. The literature has built up a large body of knowledge that suggests a potentially important role for independent central banks. However, these results are generally obtained under the assumption that delegation of policy making is irrevocable: if delegation is irrevocable and agency personnel gain nothing from reneging on policy announcements, private actors are likely to find policies under delegation to be more credible. However, delegation is inevitably a political choice which in practice can be reversed. In this paper we therefore examine policy making with and without delegation, relaxing the assumption that delegation is irreversible.

We compare the credibility of monetary policy under three institutional arrangements: government with a single decision maker, with checks and balances, and with checks and balances and delegation to an independent central bank. Within these arrangements, we consider additional variants related to the assignment of agenda control and the extent of political polarization.

In the second half of the paper, we offer detailed empirical tests that strongly support the model's predictions. These tests use new data both on political institutions and on political polarization and show for the first time that, controlling for political institutions, legal central bank independence can reduce inflation in both developing and developed countries, and that this effect depends on the extent to which political decision makers are polarized.

2. A review of solutions to the credibility problem

The time consistency problem in monetary policy, identified by Kydland and Prescott (1977) and Barro and Gordon (1983a), is well-known: a government represented by a single actor which makes an initial announcement of monetary policy will have an incentive to generate increased inflation once the private sector has formed its inflation expectations. Anticipating this *ex post* incentive, private agents build this inflation bias into their wage contracts.

Barro and Gordon (1983b) proposed that reputational effects can solve the time-consistency problem. Given a sufficiently high discount factor, the threat of future losses imposed by price-setters revising their inflation expectations upwards will mean that a government has more to lose from reneging on its inflation announcement than it stands to gain from temporary positive shocks to income. However, the reputational outcome is but

one of multiple possible equilibria in this infinitely repeated game.¹ Moreover, for many governments heavy discounting of the future will eliminate reputational equilibria. Pressures to avoid the next coup or to win the next election will be sufficiently great that a government will not value future losses more highly than current gains from opportunistic behavior.

Rogoff (1985) suggested that the delegation of monetary policy to an independent central bank that places greater weight than society at large on stabilizing prices relative to stabilizing output could be an alternative solution to the time-consistency problem. He assumed away the possibility that political actors might reverse their decision to delegate or that they might otherwise influence decisions taken by the central bank. Nearly all subsequent research has retained this assumption.² However, substantial evidence from the study of American politics suggests that partisan identification of political actors affects the decisions of nominally independent bureaucratic agencies (Weingast and Moran, 1983; also Muris' comment and their rejoinder (1984)).

Lohmann (1998) and Moser (1999) relax the irreversibility assumption in their analyses of central bank independence. As we do, they argue that multiple veto players in government make it more difficult to reverse a decision to delegate, giving independent central banks greater scope to reduce the inflation bias.³ In our theoretical and empirical

¹ Similar problems of multiple equilibria arise when monetary policy is modeled as a repeated game with incomplete information, where reputational effects involve changing beliefs about a policy maker's "type".

² More recent models of central bank independence involving incentive contracts (Walsh, 1995; Persson and Tabellini, 1993) or inflation targets (Svensson, 1997) assume that central bank independence is irrevocable. Lohmann (1992) suggests that society could improve on Rogoff's solution of delegation to a conservative central banker if there were implicit escape clauses in the case of severe supply shocks, but the mechanism through which these clauses would be enforced is not specified.

³ In this paper we use the terms veto player and political actor interchangeably.

analysis we address several questions not encompassed by their contributions. Under what conditions do checks and balances, by themselves, mitigate the credibility problem that increases expected inflation? How do changes in agenda control and political polarization affect the impact of checks and balances on firm expectations? Given checks and balances, the assignment of agenda-setting authority and political polarization, what additional influence does an independent central bank have on expected inflation?

3. A model of checks and balances, central bank independence and inflation

The model of the time consistency problem in monetary policy that anchors this paper follows Barro and Gordon (1983a). The government minimizes

$$(1) \quad L_G = \frac{1}{2} \pi_t^2 + \frac{1}{2} b_G (y_t - y^*)^2 \quad \text{with respect to } \pi, \text{ where}$$

$$(2) \quad y_t = \pi_t - \pi_t^e + \varepsilon_t,$$

where π^e = expected inflation, the price increases that are programmed by the private sector in their contracts prior to the realization of the economic shock and the policy decisions of the government and where y^* is desired output. Contracts are written first, setting prices and forming expectations about inflation, then a shock to the economy is experienced, and then the government sets actual inflation.

Private actors know that, after the shock is realized, government will set inflation depending on their own contractual decisions that set expected inflation, given by π^e . That is, the government will solve for the inflation outcome that minimizes its losses, or, from the minimization of (1):

$$(3a) \quad \pi_t = \frac{b_G (\pi^e - \varepsilon + y^*)}{1 + b_G}.$$

After taking expectations, solving for expected inflation and substituting back into (3a), the problem yields the following well-known solution for inflation (suppressing time subscripts here and throughout).

$$(3b) \quad \pi = b_G y^* - \frac{b_G}{1+b_G} \varepsilon.$$

The inflation bias – the amount of extra inflation generated by the inability of the government to credibly commit to its announced inflation policy – is $b_G y^*$.

Discretionary monetary policy under checks and balances

The model in this paper is developed in two stages. In the first, a second political actor is introduced. To capture the idea of checks and balances, both political actors must agree on any change in policy.⁴ In the second stage, we add an independent central bank.

The two political actors, E and L (the executive and legislature), minimize loss functions as described by (1) and (2):

$$(4) \quad L_i = \frac{1}{2} \pi^2 + \frac{1}{2} b_i (\pi - \pi^e + \varepsilon - y^*)^2.$$

Each has different preferences, $b_E, b_L > 0$, with respect to the tradeoff between income and inflation. We examine both the case where $b_E < b_L$, where the executive is more inflation-averse than the legislature, and the reverse case, $b_L < b_E$. The supply shock ε is uniformly distributed over $[-c, c]$.

⁴ There are a number of reasons why multiple political actors might have an influence on monetary policy in the absence of checks and balances. In a parliamentary system, for example, the minister of finance has nominal control of monetary policy, but monetary policy decisions may well be debated in cabinet or among members of the governing coalition. In presidential systems, legislatures may exercise veto power over the borrowing authority of government.

The order of events is the following. First, price-setters write wage contracts, fixing expected inflation. A shock occurs and political actors then decide what monetary policy to adopt. The action taken by government, if any, depends on the realization of the supply shock ε_t . If political actors do not agree on a new rate of inflation, a default inflation outcome prevails. The default option is an important feature of the model since, in real-world decision making, the outcomes that arise from doing nothing affect the willingness of veto players to accept new policy proposals.⁵ The process outlined in equations (1) and (2) allows inflation to differ from expected inflation only if government decision makers undertake some policy action after the realization of the shock. If government decision makers cannot agree to undertake any action, then we assume that actual inflation after the shock is realized equals expected inflation – the wage increases that private actors have built into their contracts prior to the shock.

As in the original Barro-Gordon model, private agents write their contracts prior to the shock, anticipating that each political actor would most prefer the following inflation policy after the shock (conditional on the price inflation they have built into their contracts):⁶

$$(5) \quad \pi_i = \frac{b_i(\pi^e - \varepsilon + y^*)}{1 + b_i}.$$

Since the preferences of the Executive and Legislature diverge, the inflation outcome depends on how their individual preferences are reflected in the final government decision.

⁵ The seminal article is Romer and Rosenthal (1979). This is a crucial difference between our model and that presented by Moser (1999), who assumes that under pure checks and balances the two actors always change inflation through a bargaining process where they minimize the sum of their loss functions. Neither actor is permitted to reject this solution in favor of the default outcome.

That is, the inflation outcome depends on the decision making rules used to make policy.

We assume that the decision making process endows the Executive with agenda-setting authority – the ability to make a take-it-or-leave-it offer to the other decision maker. The Executive may be more or less inflation-tolerant than the Legislature (b_E may be greater than or less than b_L).⁷

We solve for expected inflation, as usual, through backwards induction. In the last period, the political actors observe expected inflation – the contracts fixed in the private sector – and the supply shock. From (5) we know that the size of the shock affects whether each decision maker's *ex post* preferred inflation outcome is greater or less than expected inflation: the larger the supply shock, the lower is the inflation rate preferred by the political decision relative to expected inflation. After the shock is realized, there are three possible orderings of the preferred inflation outcomes of the Executive and Legislature relative to the default inflation outcome. When $b_E < b_L$, these are

$\pi^e < \pi_E < \pi_L$; $\pi_E < \pi^e < \pi_L$; and $\pi_E < \pi_L < \pi^e$. When $b_L < b_E$, the ordering is the reverse:

$\pi^e > \pi_E > \pi_L$; $\pi_E > \pi^e > \pi_L$; and $\pi_E > \pi_L > \pi^e$. In each case, these three alignments give

rise to four possible inflation outcomes. The private actors attach probabilities to each of these outcomes in establishing their inflation expectations. The four outcomes germane to the case where the Executive is less inflation-tolerant than the Legislature are:

⁶ Minimizing (4) with respect to π and solving for it from the first order condition.

⁷ In the literature on legislative bargaining the actor with agenda setting power is sometimes chosen randomly by nature (e.g., Baron and Ferejohn, 1987, 1989). This is unnecessary in the case of monetary policy, when the most plausible assumption is that private actors observe the identity of the agenda setter prior to writing their contracts.

Case I: $\pi^e < \pi_E < \pi_L$

In Case I, after the supply shock is realized, both the Legislature and Executive prefer any inflation outcome greater than the default outcome. Since the Executive has agenda control, she can therefore propose her most preferred outcome, which is greater than the default outcome, and the Legislature will agree to it. Given expected inflation, government decision makers therefore agree on the inflation outcome described in (6):

$$(6) \quad \pi = \frac{b_E(\pi^e - \varepsilon + y^*)}{1 + b_E}.$$

Case II: $\pi_E < \pi^e < \pi_L$

With this alignment in preferences, there is no inflation outcome that the Executive would prefer to the default outcome *and* that the Legislature would accept. Hence, the default outcome is retained. In this case, expected inflation and actual inflation are the same, *ex post*, and:

$$(7) \quad \pi = \pi^e$$

Case III: $\pi_E < \pi_L < \pi^e < 2\pi_L - \pi_E$

In both Cases III and IV, the Legislature and Executive prefer lower inflation than would prevail under the default outcome. Depending on the size of the supply shock, there are two possible inflation outcomes the Executive might propose, one given by Case III and one by Case IV.

The Executive would like to choose the lowest inflation outcome possible that meets the condition that the Legislature is indifferent between the low inflation outcome and the default outcome. The losses of government decision makers rise as inflation outcomes

deviate above or below their preferred inflation outcomes. It is therefore feasible for the agenda setter (the Executive) to successfully propose an inflation outcome less than the Legislature's preferred inflation outcome when default inflation is above the Legislature's preferred outcome. We assume that the Executive follows a simple rule in selecting this alternative: she chooses an inflation alternative such that the difference between the Legislature's preferred outcome and the proposed alternative is equal to the difference between default inflation and the Legislature's preferred outcome.⁸ That is, an inflation outcome π is chosen such that $\pi_L - \pi = \pi^e - \pi_L$, or

$$(8) \quad \pi = \frac{2b_L(\pi^e - \varepsilon + y^*)}{1 + b_L} - \pi^e.$$

Case IV: $\pi_E < \pi_L < 2\pi_L - \pi_E < \pi^e$

Under Case IV the default is sufficiently large relative to the Legislature's preferred outcome that $\pi_E > 2\pi_L - \pi^e = \pi$. By following the decision rule in Case III the Executive would overshoot, and choose an inflation outcome even lower than her preferred outcome. In this situation, Case IV, therefore, the Executive instead chooses $\pi = \pi_E$ or, as in Case I,

$$(9) \quad \pi = \frac{b_E(\pi^e - \varepsilon + y^*)}{1 + b_E}.$$

⁸ In principle, the Executive should propose an inflation policy π such that $L_L(\pi) = L_L(\pi^e)$. The expression for π resulting from this quadratic equation, however, renders subsequent analysis intractable. To retain tractability without sacrificing predictive power, we assume that the Legislature is indifferent between inflation that is x points higher than its preferred outcome and x points lower. We know, from differentiating (4) with respect to π , that losses actually increase faster at higher levels of inflation. The impact of our assumption is therefore to understate the Executive's agenda setting authority when $b_E < b_L$: strictly speaking, if default inflation is x points greater than the Legislature's preferred outcome, the Executive can actually make an offer to the Legislature more than x points below the preferred outcome. By the same token, the assumption overstates the bargaining power of the Executive when $b_L < b_E$.

Private actors therefore face four possible reactions by government to the contracts that they sign, given by (6) - (9). Their calculation of expected inflation is therefore the solution to

$$(10) \pi^e = q_1 \left[\frac{b_E(\pi^e - \hat{\varepsilon}_1 + y^*)}{1 + b_E} \right] + q_2 \pi^e + q_3 \left[\frac{2b_L(\pi^e - \hat{\varepsilon}_3 + y^*)}{1 + b_L} - \pi^e \right] + q_4 \left[\frac{b_E(\pi^e - \hat{\varepsilon}_4 + y^*)}{1 + b_E} \right]$$

where the q_i 's are the probabilities that the government will choose each of the four different inflation outcomes after the shock is realized. They sum to one. The $\hat{\varepsilon}_i$ are the expected values of the economic shock conditional on the particular case arising. For example, taking expected inflation as given, it is evident that Case IV can only emerge for high realizations of the supply shock; $\hat{\varepsilon}_4$ is the expected value of the supply shocks over the range of shocks conditional on Case IV occurring. Assuming a uniform distribution for ε , one can derive expressions for the probabilities and for the expected shocks, and then for expected inflation. This derivation is found in Annex 2, where Equation A.12 is the quadratic equation that gives the solution to expected inflation. Annex 2 also presents the case where the Executive is more inflation-tolerant than the Legislature ($b_L < b_E$). Equation A.13 is the expression for expected inflation in this case.

We can use numerical simulations based on equations A.12 and A.13 to generate comparative statics from the model to assess changes in expected inflation when we move from the Executive as sole decision maker to checks and balances. First, what is the impact of the assignment of agenda control on the effect of checks and balances? Second, what is the impact of “mean-preserving” polarization of the preferences of the two decision makers,

where “mean-preserving” is defined as an increase in $|b_L - b_E|$ holding $(b_L - b_E)/2$ constant?

Figure 1 illustrates the answers to these questions.

Figure 1 shows that expected inflation is far lower if the agenda setter (executive) is more inflation-averse (the lower part of the figure) than more inflation-tolerant (the upper part). Another way to see the importance of the agenda setter is to consider the case where there is no agenda setter and the two actors simply agree to minimize the sum of their loss functions. In this case, the inflation bias equals $(b_L - b_E)y^*/2$.⁹ Under the assumptions of Figure 1, this results in an expected value of inflation of 3 for all levels of polarization, lower than if there is an inflation-tolerant agenda setter, and higher than if the agenda setter is inflation-averse.

Regardless of the preferences of the agenda setter, expected inflation lies increasingly below the executive-only case as decision makers are more polarized; this effect is more pronounced when the agenda setter (the executive) is less inflation-averse. This asymmetry is explained by the fact that polarization has two effects that operate differently depending on whether the agenda setter is more or less inflation-averse.

First, as polarization increases, the range over which the political actors cannot agree to any change in monetary policy – Case II – also increases. This should reduce expected inflation regardless of the identity of the agenda setter since, in the region where policy makers are unable to agree on a new inflation outcome, they are in particular unable to agree on an increase in money supply to temporarily boost output at the expense of increased inflation. In Figure 1, when the Executive is the more inflation-averse actor, an increase in

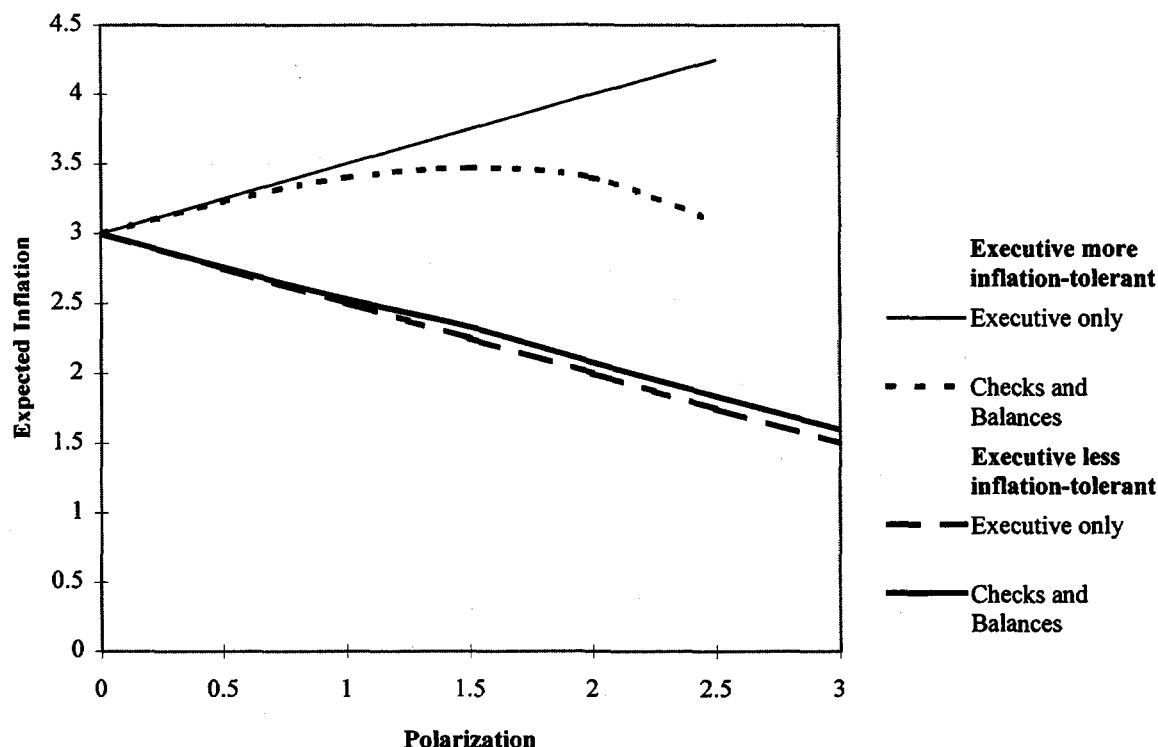
⁹ This is the institutional set-up assumed in Moser (1999).

polarization from zero to three leads to an increase in the probability of landing in the gridlock region from zero percent to 12 percent. When the Executive is the less inflation-averse decision maker, an increase in polarization from zero to 2.6 leads to an increase in the probability of retaining the default inflation outcome from zero percent to 18 percent.

Second, though, the probability of Case IV – of a supply shock so great that the Legislature prefers the Executive’s preferred outcome to the default outcome – drops. This attenuates the leverage of the agenda setter, since her ability to propose her own preferred outcome diminishes. In the case of the less inflation-tolerant Executive, for example, depicted in the lower part of Figure 1, the probability of Case IV drops from 50 percent to 32 percent as one moves from no polarization to polarization equal to three. When the Executive is more inflation-tolerant than the Legislature, this probability drops from 50 percent to 30 percent as polarization increases to 2.6. Since a reduction in the probability of Case IV essentially reduces the weight of the agenda setter’s preferences in expected inflation, the reduction has the effect of increasing expected inflation when the agenda-setter is more inflation-averse, but reducing it when the agenda-setter is less inflation-averse.

When the agenda setter is more inflation-averse, the increasing probability of Case II and the falling probability of Case IV offset each other. Consequently, the presence or absence of checks and balances creates only a small difference in expected inflation at all levels of polarization (the lower part of Figure 1). However, when the agenda setter is more inflation tolerant, the increasing probability of Case II and the declining probability of Case IV both operate to reduce expected inflation; hence, the more notable impact of polarization when the agenda setter is more inflation-tolerant (the upper part of Figure 1). At higher levels of polarization, in fact, the leverage of the agenda setter is almost completely

Figure 1: The effect on expected inflation of checks and balances, agenda control, and polarization



Note: At Polarization = 0, $b_L = b_E = 3$. Increasing polarization is mean-preserving (e.g., at polarization = 3, $b_L = 4.5$ and $b_E = 1.5$). More and less inflation-tolerant refers to whether b_L is less than or greater than b_E . The shock parameter $c = 3$, and desired output $y^* = 1$. Note that the simulation is conducted over those ranges of polarization where all cases have positive probability. When the executive is more inflation-tolerant, the probability of Case IV occurring becomes negative when polarization exceeds 2.6.

attenuated: when polarization equals 2.6, expected inflation equals 3.09, compared to three in the simple bargaining case.

The introduction of an independent central bank

The foregoing argument shows that, relative to the case where the Executive is the sole decision maker, checks and balances do not increase expected inflation significantly when the Executive is more inflation-averse, and they do reduce it significantly when the Executive is less inflation-averse. This section evaluates the contribution that an independent central bank can make in each case.

The argument that inflation-averse central bankers can reduce inflation relies on the assumption that delegation of monetary policy is difficult to reverse. Two arguments are frequently used to justify this assumption. One is that political actors bear some exogenous cost when they override a central bank (as in Jensen, 1997). In order for central bank independence to improve credibility relative to discretionary monetary policy, however, this cost must be greater than the cost a government would face if it reneged on a policy announcement in the absence of delegation.

A second argument is that central bank independence might be protected by a legal stipulation that the agreement of more veto players is required to reverse delegation than to change discretionary monetary policy. So, for example, the agreement to delegate is changed only if both the legislature and executive agree, while monetary policy in the absence of delegation could be changed by the executive alone. In practice, however, as footnote (4) suggests earlier, even in the absence of delegation the legislature is likely to influence discretionary monetary policy.

The model presented above offers a third explanation of why legal central bank independence might reduce the inflation bias, even if neither of the previous conditions hold. Because the independent central bank has agenda control, it can propose an inflation outcome, after the realization of the shock, in such a way that the less inflation-tolerant political actor is no worse off than if the central bank's decision were overturned and the two political decision makers were required to agree on an alternative.

To assess the contribution of the central bank under these circumstances, we build on the earlier model and assume that price setters establish long-term contracts, a shock occurs, the central bank determines an inflation policy, the two political actors determine whether

to accept the central bank's policy and, if they overturn it, they then agree on an alternative policy. We assume that the political actors cannot bind themselves to any particular inflation policy until they first overturn the central bank's policy.¹⁰ Therefore, the policy that prevails should they revoke the central bank's independence is precisely the policy that would have been instituted under pure checks and balances (or π_{CH} in the discussion that follows).

The central banker's loss function is

$$(11) \quad L_{CB} = \frac{1}{2} \pi_t^2 + \frac{1}{2} b_{CB} (\pi_t - \pi_t^e + \varepsilon_t - y^*)^2$$

and the central bank is more inflation-averse than either of the political actors ($b_{CB} < b_E, b_L$).

The central bank's preferred inflation policy is:

$$(12) \quad \pi_{CB} = \frac{b_{CB}(\pi^e - \varepsilon + y^*)}{1 + b_{CB}}$$

We assume that the bank is sufficiently inflation-averse that it always proposes the lowest inflation alternative that is the same distance from the most inflation-averse political actor's preferred outcome as π_{CH} ($\pi_E - \pi = \pi_{CH} - \pi_E$, when $b_L < b_E$, and $\pi_L - \pi = \pi_{CH} - \pi_L$ otherwise). That is, there is no occasion when its own preferred inflation outcome is actually greater than the outcome π chosen using this rule. Given this rule, the central bank will always propose an inflation outcome less than or equal to π_{CH} and is never overridden. The central bank makes its policy proposal after the supply shock is realized; depending on the size of the supply shock, and as before, π_{CH} can take on one of four possible values.

¹⁰ Overturning the central bank policy typically requires modifying the legislation governing central bank independence; it is implausible to expect that a conjunctural modification of monetary policy would be

Knowing that the central bank's decision depends on the realization of the shock, and that the central bank will always select an override-proof inflation outcome, private actors solve for expected inflation using equation (13), when $b_E < b_L$. This is the same as equation (9), with the difference that the central bank rather than the Executive has agenda control so that the anticipated inflation outcomes under each case are different and determined by $\pi_E - \pi = \pi_{CH} - \pi_E$.

$$(13) \pi_{CB}^e = q_1 \left[\frac{b_E (\pi_{CB}^e - \hat{\varepsilon}_1 + y^*)}{1 + b_E} \right] + q_2 \left[\frac{2b_E (\pi_{CB}^e - \hat{\varepsilon}_2 + y^*)}{1 + b_E} - \pi_{CB}^e \right] + q_3 \left[2(\pi_{CB}^e - \hat{\varepsilon}_3 + y^*) \left(\frac{b_E}{1 + b_E} - \frac{b_L}{1 + b_L} \right) + \pi_{CB}^e \right] + q_4 \left[\frac{b_E (\pi_{CB}^e - \hat{\varepsilon}_4 + y^*)}{1 + b_E} \right]$$

The term π_{CB}^e is expected inflation in the presence of a central bank. The inflation outcomes associated with each of the four probabilities, q_i , are the override-proof policies chosen by the central bank. So, for example, if the shock is such that Case I is realized, $\pi_{CB}^e < \pi_E < \pi_L$, $\pi_{CH} = \pi_E$ because if the central bank were overturned, the Executive would propose and the Legislature would accept the Executive's preferred inflation outcome. Knowing this, the central bank chooses $\pi = 2\pi_E - \pi_{CH}$, and the inflation policy in the event of Case I is therefore $\frac{b_E (\pi_{CB}^e - \hat{\varepsilon}_1 + y^*)}{1 + b_E}$. In Case II, the inflation outcome in the event of an override of the central bank's proposal is the default outcome, or $\pi_{CH} = \pi_{CB}^e$, so that the central bank proposes $\pi = 2\pi_E - \pi_{CH} = \frac{2b_E (\pi_{CB}^e - \hat{\varepsilon}_2 + y^*)}{1 + b_E} - \pi_{CB}^e$.

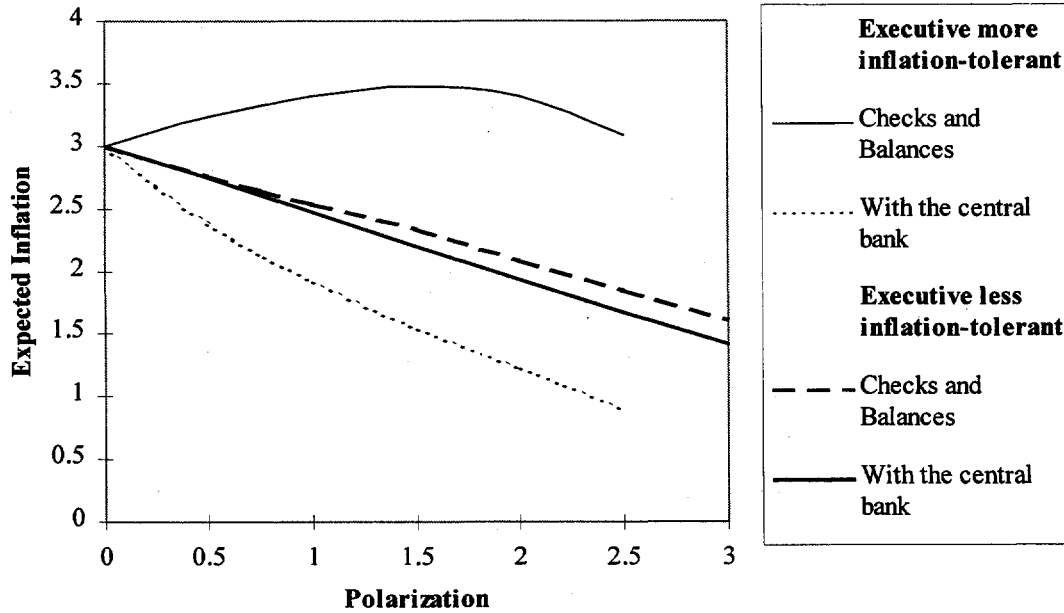
embedded in such legislation.

If the Executive – the agenda-setter – is more tolerant of inflation than the Legislature ($b_L < b_E$), the central bank then sets policy such that the Legislature has no incentive to agree to reverse the central bank. In this case, the cases remain the same, but the inflation policy chosen in each case by the central bank change, so that private actors solve

$$(14) \pi_{CB}^e = q_1 \left[\left(\frac{2b_L}{1+b_L} - \frac{b_E}{1+b_E} \right) (\pi_{CB}^e - \hat{\varepsilon}_1 + \gamma^*) \right] + q_2 \left[\frac{2b_L (\pi_{CB}^e - \hat{\varepsilon}_2 + \gamma^*)}{1+b_L} - \pi_{CB}^e \right] + q_3 \pi_{CB}^e + q_4 \left[\left(\frac{2b_L}{1+b_L} - \frac{b_E}{1+b_E} \right) (\pi_{CB}^e - \hat{\varepsilon}_4 + \gamma^*) \right].$$

The solutions to equations (13) and (14) are the private actors' calculations of expected inflation when the agenda setter is more or less inflation-averse. They are derived in Annex 3, and given by equations A.14 and A.15.

Figure 2: The effect on expected inflation of central bank independence



Note: For parameter values and definitions, see Figure 1.

Once again, using numerical simulations to generate comparative statics, we can address the second main question of the paper: how does the inflation bias with checks and balances and delegation compare with that under other institutional arrangements? Figure 2 illustrates several important predictions of the model on the impact of an independent central bank relative to checks and balances without a central bank.

First, expected inflation is always lower under checks and balances with a central bank when compared to checks and balances and no central bank. Second, the effect of a central bank is most pronounced when the agenda setter is more tolerant of inflation and polarization is high – the top and bottom lines in Figure 2.

It might seem counter-intuitive that expected inflation under the institutional combination of checks and balances, a central bank, and an inflation-tolerant executive is actually lower than under the combination of checks and balances, a central bank, and an inflation-averse executive. This result derives from the fact that the leverage of the central banker as agenda setter depends entirely on what the most inflation-averse decision maker can achieve under pure checks and balances. When this decision maker is the executive and has agenda control under pure checks and balances, she can achieve an outcome much closer to her preferred inflation outcome than if the inflation-averse decision maker is the legislature and does not exercise agenda control. The further the checks and balances outcome, π_{CH} , from the preferred outcome of the inflation-averse decision maker, the lower the inflation that the central bank can propose. Hence, the central bank has the most influence when the agenda setter, under checks and balances, is most tolerant of inflation.

4. Testing the hypotheses

The model underlines the importance of taking political institutions and preferences into account when examining the impact of administrative arrangements such as central bank independence (or judicial independence, or the impact of regulatory agencies on firm decisions). We can test three of the predictions that emerge from the foregoing analysis.

- 1) *The presence of a legally independent central bank should have a negative effect on inflation only in the presence of checks and balances.*
- 2) *Political interference, such as replacement of central bank governors, is less likely when checks and balances are present.*
- 3) *The presence of a legally independent central bank has a more negative effect on inflation when different branches of government have divergent preferences over inflation.*

The model suggests other hypotheses, related to the interaction of the agenda setter and polarization. The absence of data on agenda setters across countries means that tests of these hypotheses must be reserved for future work.

The first hypothesis bears on an unresolved puzzle in empirical work on central bank independence. A number of papers have found a statistically significant relationship between legal measures of central bank independence and inflation in advanced industrialized economies.¹¹ However, this relationship has not been found in samples that include both developed and developing countries (Cukierman, Webb, and Neyapti, 1992). We conclude, in a sample that includes both developing and developed countries, that legal independence can reduce inflation bias, but that this depends on the level of checks and

¹¹ See for example Alesina and Summers (1993), Cukierman, Webb, and Neyapti (1992) and Grilli, Masciandro and Tabellini (1991).

balances in a country's political system.¹²

The second hypothesis is relevant to previous studies of central bank independence and inflation, which have found that *de facto* measures of independence, such as the rate at which central bank governors are replaced, are negatively correlated with inflation, and that this relationship holds for both developed and developing countries. The evidence that we present below suggests that political interference in central bank decision making is more difficult under checks and balances.

Finally, the empirical results below demonstrate that the interaction effect of legal independence and checks and balances is significantly greater in more polarized environments, consistent with the third hypothesis. An additional implication of the model is that, regardless of the identity of the agenda setter, when decision makers are not polarized (the left-hand side of Figure 1), checks and balances should have little impact on expected inflation. We find that checks and balances have an insignificant effect on inflation outcomes when polarization is low and central banks are absent.

Data

As our proxy for the inflation bias, we use the log of average levels of inflation as our dependent variable.¹³ Our measure of legal central bank independence was developed by

¹² Lohmann (1998), in a case study of Germany that includes time-series tests, and Moser (1999), in an econometric investigation of 20 OECD countries, also ask how the effect of legal independence varies with levels of checks and balances. Moser does not investigate the effects of checks and balances on the turnover of central bank governors, the role of polarization, or implications for developing countries.

¹³ This is based on consumer price index data from the IMF, *International Financial Statistics*. An alternative dependent variable used by Cukierman, Webb, and Neyapti (1992) is a transformed rate of inflation $\pi/(1+\pi)$. They argue this better represents the costs to private agents of holding money balances than does the simple rate of inflation, π , and that it reduces the effect of outliers. We have opted for log inflation in our regressions both because of the ease of interpretation of a semi-log model and because using log inflation results in data which are much less heteroskedastic than when using either the simple or transformed rate of inflation.

Cukierman, Webb, and Neyapti (1992), based on sixteen different characteristics of central bank statutes such as the term of office for the governor, provisions for his or her replacement, limits on central bank lending to government, and procedures for resolution of conflicts between central bank and government. The data for *CBI* cover 72 countries and are reported by decade over the four decades from 1950 to 1989.¹⁴ The component of *CBI* which measures rules concerning the tenure of the central bank governor is also used separately and is labeled *CEO*.

These authors have also developed *de facto* measures of independence. Cukierman, Webb, and Neyapti (1992) argue that high turnover of central bank governors is indicative of low independence and show that the rate of turnover is positively and significantly correlated with inflation in a sample including both developed and developing countries. This paper uses an improved *de facto* measure of central bank independence developed by Cukierman and Webb (1995), which represents the frequency with which central bank governors are replaced in the six months following changes in government. This measure, *governor turnover*, is also positively and significantly correlated with inflation.¹⁵

With respect to checks and balances in government, one would ideally like to have information on the number of political actors who exercise veto power over monetary policy, along with the inflation preferences of these actors. Given the paucity of cross-

¹⁴ We use Cukierman, Webb, and Neyapti's weighted index which they call LVAW. Due to missing data the total number of observations for this variable is 236 (see Table II for a summary). The four periods are divided as follows, 1950-69, 1960-71, 1972-79, 1980-89.

¹⁵ In a few cases *governor turnover* could not be coded because a country did not experience a change of government during the period. This results in the exclusion of only 4 potential observations from our Table III regressions. *governor turnover* is measured in two time periods 1950-71 and 1972-89.

country data in this area, two proxy variables are used that capture the institutional aspects of checks and balances but not the preferences of the actors.

The first is the index of *executive constraints*, developed by Gurr, Jagers, and Moore in the Polity III dataset. Their measure is based on a subjective assessment of different countries over time following a pre-specified methodology where values range from one, "no regular limitations on the executives actions", to seven, when groups such as the legislature have "effective authority equal to or greater than the executive in most areas of activity". The construction of *executive constraints* has the advantage of considering not just whether there are formal, constitutional limitations on executive power but also whether these limits exist in practice.

A second, more recent measure of checks and balances developed by Keefer (1998) has the advantage of being based on objective criteria and of capturing aspects of checks and balances not measured by *executive constraints*, such as the existence of coalition governments, or divided control of two chambers in a bicameral system. The variable *checks* is constructed based on variables in a new database of political institutions assembled by Beck, Clarke, Groff, Keefer, and Walsh (1999). This data is available for the last two decades of our sample (1970-89). The index is based on a formula which first counts the number of veto players, based on whether the executive and legislative chamber(s) are controlled by different parties in presidential systems and on the number of parties in the government coalition for parliamentary systems (as described in greater detail in Annex 1). The index is then modified to take account of the fact that certain electoral rules (closed list vs. open list) affect the cohesiveness of governing coalitions. Since the effects of checks and balances

hypothesized in the model are likely to be strongest at lower levels of checks than at higher levels, we use a log version of *checks*, *log check*, in our regressions.¹⁶

In order to test the proposition regarding polarization one would ideally have information on the inflation and output preferences of different political parties. This data is not available. Instead, we use two measures of polarization. One, *political polarization*, is taken from the database of political institutions (Beck, et al.). The four largest parties and the executive in each country were scored according to whether the data sources indicated parties as having an economic orientation that was left, center or right. This information is used to assess the maximum difference between those entities that comprise the *checks* indicator explained earlier. This maximum constitutes the *political polarization* measure.

Our second measure of polarization is a society-wide indicator. The argument is simply that where society at large is more polarized, the representatives of society that are selected to the various branches of government are more likely to be polarized as well. Social polarization has been proxied in the cross-country empirical literature by data from Sullivan (1991), the size of the principal ethno-linguistic group as a percent of the population. We diverge from the literature by transforming this variable in a way that is theoretically more consistent with notions of polarization.¹⁷ Theory suggests that societies are most likely to have polarized preferences when there are a few equally sized groups, as opposed to one dominant group or many smaller groups. The variable *social polarization* is

¹⁶ Otherwise this variable would give as much weight to a change from 1 to 2 veto players as from 4 to 5; since our model speaks to the first case and is silent about the second, the log formulation is more appropriate.

¹⁷ The pioneering paper here is Easterly and Levine (1997). Unlike us, they assume a monotonic relationship between ethnic fractionalization and social polarization.

therefore a transformation of the Sullivan measure to more closely approximate this theoretical requirement.¹⁸

Table I: Summary statistics

Variable	No. obs.	mean	std. Dev.	min.	max.
<i>log inflation</i>	217	-2.53	1.12	-5.81	0.81
<i>CBI</i>	236	0.34	0.13	0.09	0.69
<i>CEO</i>	236	0.48	0.20	0.06	0.94
<i>Governor turnover</i>	194	0.26	0.33	0	1.5
<i>Executive constraints</i>	226	4.73	2.24	1	7
<i>log check</i>	133	0.95	0.47	0	1.92
<i>Openness</i>	197	0.30	0.23	0.03	1.90
<i>political polarization</i>	132	0.51	0.78	0	2
<i>social polarization</i>	162	1343	823	0	2499
<i>log GDP</i>	171	1.18	1.02	-1.26	280

We use one additional control variable, *openness*, measured as imports of goods and services divided by GDP (*International Financial Statistics*). This follows Romer (1993), who argues that as imports increase as a share of total consumption, policy makers have less of an *ex post* incentive to inflate. Since the central bank independence variable is only available by decade, other controls, such as GDP growth, or terms of trade movements, are precluded.

¹⁸ This variable attains its maximum when the largest ethnic group represents 50% of the population and its minimum when the largest ethnic group represents either 0% or 100% of the population. The formula is *social polarization* = (% share largest group) – (% share largest group)² where data on ethnic groups is used from Sullivan (1991). This approach yields a variable that matches the theoretical requirements of polarization outlined in Esteban and Ray (1994).

However, we follow Cukierman, Webb, and Neyapti (1992) and include decade dummy variables to control for unobserved characteristics specific to each time period.

Testing proposition 1: checks and balances and central bank independence

In order to examine whether legal central bank independence has a stronger negative impact on inflation in countries with checks and balances, we use a model with interaction terms that allows the marginal effect of central bank independence on inflation to vary with the extent of checks and balances. The general form of regressions 2-4 in Table II (decade dummies omitted) is shown in equation 15.

$$(15) \log inflation = \alpha + \beta_1 CBI + \beta_2 \text{checks var.} + \beta_3 (\text{checks var.} * CBI) + \beta_4 \text{openness}$$

The interaction term is predicted to have a negative coefficient. The net effect of central bank independence, given by $\beta_1 + \beta_3 * (\text{checks variable})$, should be to reduce inflation only at high levels of checks and balances. Table II reports the results of four OLS regressions.

The theoretical analysis demonstrates that, under a range of circumstances, the mere presence of checks and balances can generate a lower inflation bias. Regressions 1 and 2 provide support for this argument: the coefficients on *executive constraints* and on *log check* are negative and significant. As in previous research, legal central bank independence has no significant impact on inflation when it enters linearly, and openness is significantly and negatively correlated with inflation.

Regressions 3 and 4 test our first hypothesis, interacting legal central bank independence with three different measures of checks and balances. The interaction term is negative and significant, as predicted, in both cases. The combined effect of an increase in

central bank independence (taking into account both the linear term *CBI* and the interaction term) is negative in both regressions at high levels of checks and balances.

Table II: Checks and balances, central bank independence, and inflation

depvar: log inflation	(1)	(2)	(3)	(4)
Constant	-2.16 (0.27)	-0.98 (0.33)	-3.15 (0.42)	-2.17 (0.63)
<i>CBI</i>	-0.19 (0.44)	0.11 (0.64)	3.14 (1.30)	3.48 (1.82)
<i>openness</i>	-1.15 (0.26)	-1.17 (0.28)	-1.17 (0.26)	-1.22 (0.29)
<i>executive constraints</i>	-0.11 (0.03)		0.08 (0.06)	
<i>CBI * exec. constraints</i>			-0.60 (0.20)	
<i>log check</i>		-0.66 (0.21)		0.47 (0.53)
<i>CBI * log check</i>				-3.16 (1.48)
R²	0.39	0.21	0.42	0.24
N	183	123	183	123
p-value for F stat.	p < 0.01		P < 0.01	p < 0.01

OLS with White's heteroskedastic consistent standard errors reported in parentheses. Period dummies not reported.

More concretely, in a parliamentary system with a three party governing coalition (*log check*=1.6), a one standard deviation increase in legal central bank independence would be predicted to reduce annual average inflation by approximately 20 percent.¹⁹ In contrast, in a parliamentary system with a single party majority (*log check*=1.1), the predicted change in inflation would be close to zero (0.1 percent higher than otherwise). This suggests an explanation for Cukierman, Webb, and Neyapti's finding that *CBI* is significantly and

¹⁹ That is, for example, a drop in inflation from 10 percent per year to 8 percent per year.

negatively correlated with inflation in advanced industrial countries but not in developing countries: developing countries, on average, have lower levels of checks and balances.

Testing proposition 2: checks and balances and political influence on central banks

While our results show that *legal* central bank independence is predicted to have a more negative effect on inflation at high levels of checks and balances, our model also has implications for *de facto* measures of central bank independence, such as the frequency with which central bank governors are replaced following changes in government (*governor turnover*). Replacement of governors should be more difficult when a central bank's statutes offer tenure guarantees *and* when checks and balances are present. In the absence of checks and balances, legal protections of tenure are easier to modify and therefore less effective in constraining political actors.

This argues in favor of estimating a system of equations where inflation is a function of governor turnover, and governor turnover is itself endogenous to legal protections of tenure and checks and balances. Equations 16 and 17 below describe such a system (with period dummies omitted and recalling that *CEO* measures legal protection of tenure). A variable for checks and balances is included in both equations, because our model predicts that checks may have a direct effect on inflation as well as an indirect effect (via central bank independence). The variable *CEO*, on the other hand, should only influence inflation through its effect on governor turnover.

$$(16) \quad \text{governor turnover} = \alpha + \beta_1 \text{CEO} + \beta_2 \text{checks var} + \beta_3 \text{checks var} * \text{CEO}$$

$$(17) \quad \log \text{inflation} = \alpha + \beta_4 \text{governor turnover} + \beta_5 \text{openness} + \beta_6 \text{checks var}$$

Table III reports results from Two Stage Least Squares estimation of these equations. The key result is actually the first equation in each of the two models (one model for each measure of checks), which tests proposition 2, that turnover of central bank governors is determined by the interactive effect of checks and balances and laws protecting the tenure of governors. The interaction term in our estimations of equation (16) has the expected negative sign in each case. The higher the level of checks and balances, the more negative the predicted political influence on the central bank. In the case of the system estimated using *log check*, the interaction term is significant at the 5 percent level while the interaction term in the system estimated with *executive constraints* has the expected sign but is not statistically significant.

The second equation in each model bears on the finding in prior research that legal central bank independence is an insignificant determinant of inflation, but governor turnover a significant determinant, in samples that include both rich and poor countries. The discussion of the first proposition explains one part of this anomaly: the insignificance of legal central bank independence results from the omission of political institutions. The second equations in Table III suggest an institutional explanation for the other part of the anomaly, as well. The value of turnover predicted from political and legal institutions has a positive influence on inflation, although the coefficients on *governor turnover* are not significant at conventional levels.

The substantive results are also consistent with those from the test of proposition 1. In a parliamentary system with a ruling coalition of three parties (*log check* = 1.6), a one standard deviation increase in *CEO* is predicted to change *governor turnover* by -0.07, translating into a decrease in annual average inflation of 13 percent. In contrast, in a similar

system with a single party government ($\log check = 1.1$), a one standard deviation increase in CEO has essentially no effect on turnover (+0.003) or inflation (+0.5 percent).

Table III: Formal independence, *de facto* independence and checks and balances

Dep. Variable →	Model 1		Model 2	
	<i>turnover</i>	<i>ln(inflation)</i>	<i>turnover</i>	<i>ln(inflation)</i>
Constant	0.25 (0.16)	-3.48 (1.17)	0.17 (0.21)	-2.11 (0.80)
<i>Governor turnover</i>		2.95 (2.51)		1.79 (1.26)
<i>Openness</i>		-0.68 (1.10)		-1.62 (0.58)
<i>CEO</i>	0.26 (0.28)		0.85 (0.42)	
<i>Exec. Constraints</i>	-0.03 (0.02)	-0.01 (0.09)		
<i>CEO * exec. Constraints</i>	-0.03 (0.05)			
<i>log check</i>			0.09 (0.19)	-0.05 (0.35)
<i>CEO * log check</i>			-0.76 (0.39)	
R²	0.14	0.27	0.15	0.24
N	163	163	106	106
Prob > Chi² model	p < 0.01	P < 0.01	P < 0.01	p < 0.01

Two-stage least squares; the first stage (not reported here) is turnover as a function of openness, CEO, CEO*checks variable, and the checks variable. Period dummies not reported.

Testing proposition 3: polarization and central bank independence

Checks and balances should matter most when there are preference differences among various political veto players. Our model predicts that the higher the level of

polarization between veto players in government (with respect to inflation and output preferences), the greater the impact of central bank independence and checks and balances on inflation.²⁰ To test this proposition, we re-run the regressions from Table II, splitting the sample between high polarization and low polarization country-decades (based on the median value of our two polarization variables *social polarization* (in Table IV) and *political polarization* (in Table V)).

The first notable result in the two tables is that, as we would predict from Figure 1, the presence of checks and balances makes little difference in expected inflation at low levels of polarization and at low levels of central bank independence. At higher levels of polarization, the effect of checks and balances depends on details of the agenda-setting institutions about which we have no cross-country data.

The results are also consistent with the predictions of proposition 3. For both measures of polarization and both measures of checks and balances, the interaction terms *CBI* * checks are of the largest magnitude, negative and highly significant in the high polarization sub-samples. In the low polarization sub-samples, the interaction terms are generally small and not statistically significant. The exception is the interaction term using *executive constraints* in the low polarization sub-sample of Table V. However, although it is negative and significant, it is nonetheless smaller in magnitude than the coefficient on the interaction term in the high polarization sub-sample.

²⁰ These effects should vary with the identity of the agenda setter, which we cannot capture in our empirical tests. Polarization can also have other effects that we do not model. Alesina and Gatti (1995) argue that central bank independence will reduce variance of output and of inflation in countries with polarization *across* governments by minimizing partisan business cycles.

Table IV: *Social polarization, central bank independence, and checks and balances*

depvar: log infl.	low pol	high pol	Low pol	high pol
constant	-1.72 (1.00)	1.35 (0.23)	-0.96 (1.41)	-2.40 (0.66)
<i>CBI</i>	-1.16 (2.48)	5.67 (1.73)	-0.10 (3.64)	4.66 (1.98)
<i>openness</i>	-1.10 (0.90)	-1.37 (0.30)	-2.16 (0.79)	-0.98 (0.26)
<i>exec. constraints</i>	-0.10 (0.14)	0.19 (0.08)		
<i>CBI * exec. constraints</i>	0.04 (0.37)	-1.04 (0.28)		
<i>log check</i>			-0.17 (1.11)	0.11 (0.52)
<i>CBI * log check</i>			-0.32 (3.11)	-2.94 (1.45)
R^2	0.38	0.55	0.18	0.40
N	90	87	55	62
p-value for F stat.	p < 0.01	p < 0.01	p = 0.11	p < 0.01

Table V: *Political polarization, central bank independence, and checks and balances*

depvar: log infl.	low pol	high pol	Low pol	high pol
<i>CBI</i>	4.97 (1.84)	10.13 (5.00)	1.20 (3.24)	4.65 (2.66)
<i>openness</i>	-1.26 (0.30)	-1.30 (0.71)	-1.11 (0.31)	-1.25 (0.86)
<i>exec. constraints</i>	0.17 (0.11)	0.24 (0.23)		
<i>CBI * exec. constraints</i>	-0.89 (0.33)	-1.57 (0.73)		
<i>log check</i>			-0.83 (1.10)	1.05 (0.72)
<i>CBI * log check</i>			-0.10 (3.22)	-4.40 (1.88)
R^2	0.31	0.22	0.33	0.16
N	66	51	72	50
p-value for F stat.	p < .001	p = 0.01	p < .001	P = 0.06

Note: OLS with White's heteroskedastic consistent standard errors reported in parentheses. Period dummies not reported. It was not possible to split the samples evenly in Table V because political polarization had a value for zero for more than half of the observations.

Robustness

The evidence presented in this section indicates that our results are not driven by serial correlation, by the endogeneity of legal central bank independence to inflation or lagged inflation, by omitted variables, including political instability, nor by outliers.

Results of Lagrange multiplier tests suggest serial correlation of the error terms might have led to inconsistent estimates of standard errors in the tests of the first two propositions.²¹ However, the results in Tables II and III are robust to controls for serial correlation.²² In particular, regressions 3 and 4 of Table II are robust to the inclusion of a lagged dependent variable.²³ Similarly, the introduction of a lagged inflation variable in the tests of proposition two had little effect on the results in Table III. Since the introduction of a lagged dependent variable significantly reduces sample size, we have preferred to present results from the original specification in Tables III and IV.

It is possible that countries adopt legally independent central banks in response to bouts of high inflation, perhaps prodded by the international financial community, making CBI endogenous to lagged values of inflation, a second possible source of inaccuracy in our results. There are both theoretical and empirical responses to this possibility. Theoretically, the model and the tests reported in Table II are valid even if the adoption of central bank

²¹ The null of no autocorrelation was rejected at the $p < .001$ for each of the regressions.

²² Our preferred methods of addressing the problem (such as using Newey-West standard errors) are infeasible since they yield inconsistent results in data sets with small numbers of time periods relative to cross-section observations.

²³ P-values for the coefficients on the interaction terms in the *checks* and *executive constraints* specifications both remained significant at the 10% level (at $p=0.067$ and $p=0.068$ respectively). Lagrange multiplier tests following the inclusion of a lagged dependent variable could not reject the null hypothesis of no autocorrelation. We also transformed our data set into cross-section variables over the whole time period. If serial correlation were responsible for the results we report, these results should disappear in cross-section regressions. Results for *executive constraints* remained significant, and results using *log checks* retained the correct sign.

independence is motivated by high bouts of inflation. If past inflation leads countries to adopt central bank independence, we predict that the effects of this would be different in high and low checks countries. In low checks countries, this process would lead to a positive association between inflation and central bank independence, since private actors would not view independence as credible and inflation persistence would therefore not be reversed. In high checks countries, on the other hand, the adoption of an independent central bank in response to past inflation would reduce inflation expectations.

Empirically, we find little evidence that central bank independence is endogenous to lagged inflation, in any case. *CBI* is not “Granger-caused” by lagged inflation. Similarly, the *CEO* component of *CBI*, used in the tests of proposition two to capture legal provisions regarding governor tenure, is not “Granger-caused” by lagged inflation. Granger tests do suggest that *de facto* central bank independence as measured by governor turnover is significantly correlated with lagged inflation. However, when we estimate the regressions in Table III including lagged inflation as a right-hand variable in the turnover regressions, the results are consistent with the initial regressions, although the sample size is significantly reduced.²⁴

It is also possible that *CBI* or *CEO* are endogenous to contemporary inflation, since the four periods encompassed by the data are each long, as much as 11 years. However, when we instrument for *CBI* with lagged *CBI* in the tests in Table II, Hausman specification

²⁴ In the *check* specification in Table III, the interaction term in the turnover regressions actually increased slightly in magnitude and became more significant with coefficient -0.80 and standard error (0.38) . In the *executive constraints* specification the interaction term remained negative but was not significant -0.024 (0.055) .

tests do not reject the original OLS estimates.²⁵ Results are similar when we instrument for *CEO* with lagged *CEO* in the Table III turnover regressions which test proposition 2.²⁶

The influence of omitted variables on central bank independence, checks and balances and inflation is a third possible source of spurious results in the regressions presented earlier. However, our results are robust to the inclusion of additional variables suggested by the literature.

The first of these is income per capita. A country's level of income might simultaneously influence both inflation and the efficacy of an independent central bank. If this were the case, central bank independence should not be a significant determinant of inflation, after controlling for income, and income itself should be significant. However, when entered into our Table II regressions, the log of real GDP per capita is never significant and leaves the estimates of the interaction terms nearly unchanged.²⁷

Nor is it the case that checks and balances are simply proxies for income per capita. It is true that the checks and balances variables are correlated with income. The question, then, is whether the results for the interaction terms *CBI* * checks are spurious, and driven by the relationship of checks and balances to income. If this were the case, our findings

²⁵ The null that the differences between the parameter estimates from an OLS estimation of regressions 3 and 4 from Table III and an instrumental variables estimation are not significant (and thus that the OLS estimates were consistent) could not be rejected in any of the three cases. These tests also involved instrumenting for the interaction term *CBI* x checks var. P-values for the tests in the *check* and *executive constraints* specifications were $p=0.97$ and $p>0.99$.

²⁶ This involved estimating the turnover regressions alone, rather than the two-equation system. Based on a comparison of OLS and IV estimates of the governor turnover regressions, in the *checks* and *executive constraints* specifications the p-values for the Hausman specification test were $p>0.99$ and $p=0.91$. In addition, *CEO* was not significantly correlated with lagged inflation.

²⁷ In regressions 3 and 4 p-values for the coefficient on real GDP are 0.98 and 0.35 respectively. The coefficients and standard errors for our interaction terms in each regression are -0.47 (0.21) and -2.52 (1.55).

would simply be replicating earlier results showing that *CBI* is significantly correlated with inflation in developed countries but not in developing countries.

To assess this possibility, we compare the explanatory power of specifications in regressions 2,3 and 4 of Table II with a specification that substitutes *log GDP* and *log GDP*CBI* for the respective checks variables and checks**CBI* variables. The J-test proposed by Davidson and MacKinnon (1981) allows us to compare the explanatory power of the alternative specifications. These tests strongly reject the GDP specification in favor of the *executive constraints* and *log check* specifications.²⁸ We repeated this exercise with the two regressions in Table III in which governor turnover is the dependent variable. In both cases, the J-test rejects the GDP specification in favor of the checks specification.²⁹

A second omitted variable is the interaction of openness and legal central bank independence. Romer (1993) argues that the negative association between openness and inflation is weaker in countries with more independent central banks, suggesting that an interaction term, *CBI * openness*, should be included in regressions attempting to assess the impact of independence on inflation.³⁰ There are two ways to examine the robustness of our results to Romer's argument.

²⁸ These tests involve estimating the two alternative specifications and then re-estimating each specification while including the fitted values from the alternative model as a parameter. The *t*-statistic on the fitted values can be interpreted as a test of the null that the alternative specification would not add explanatory power to the existing model. In the case of the existing regressions 3 and 4 the null could not be rejected ($p=0.59$ and $p=0.10$ respectively) while in the case of the GDP specification the null was rejected ($p=0.01$ and $p=0.04$).

²⁹ Based on OLS estimates of this equation, in the three existing specifications using the checks variables the null could not be rejected (*exec. constraints* $p=0.50$, *log check* $p=0.39$). With the GDP specifications the null was always rejected at $p < 0.01$.

³⁰ His tests of this proposition are only successful with indices of independence that include measures of governor turnover, however.

First, we add the interaction term *CBI * openness* to the Table II specifications.³¹ This interaction term is not significant in any specification, consistent with Romer's own investigation. More importantly, the *CBI * checks* interaction terms generally retain their significance. Second, we add an interaction term *governor turnover * openness* to our inflation regressions in Table III. In this case as well, the openness interaction term is never significant and its inclusion does not affect the results reported earlier.

It might also be argued that political instability explains our results: countries that exhibit checks and balances are less stable, and it is their instability, rather than checks and balances, that generates our results. The evidence suggests that this is not the case, however. First, the correlation between three measures of political instability and the *checks* variable (all from the Database of Political Indicators) is slightly positive (7 percent) in two cases, and negative (-17 percent) in a third case. Second, the results in Table III are robust to the inclusion of instability.

A final robustness issue concerns the influence of outliers.³² In general, after outliers are excluded, our results are still consistent with our theoretical propositions concerning inflation, central bank independence, and checks and balances. There is only one notable change in the Table II regressions after the exclusion of outliers: the coefficient on the interaction term *CBI * log check* becomes less negative (-2.45), but nevertheless remains highly significant. The interaction term *CBI x exec. constraints*, though, remained both

³¹ Since this hypothesis is not mutually exclusive with our checks hypothesis, a non-nested test like the J-test is not appropriate here.

economically significant (coefficient equal to -0.59) and statistically significant. Similarly, in the 2SLS regressions in Table III, results with regard to the two interaction terms *CEO * checks* and *CEO*executive constraints* are similar to the original estimates after outliers are excluded.³³ In particular, governor turnover retains a high association with the interaction terms, although the association between governor turnover and inflation weakens after outliers are excluded.

Finally, results on polarization in Tables IV and V are largely robust to the exclusion of outliers. In Table IV, the coefficients on the interaction terms in the low polarization sub-samples remain insignificant, while in the high polarization sub-samples they remain economically large and of the right sign, but in one of the two cases lose statistical significance.³⁴ For the Table V regressions, the results for the *executive constraints* regressions were also robust to the exclusion of outliers. The results for the regressions using *check* were not robust, however.³⁵

5. Conclusion

Governments seek to improve the quality and credibility of policy making by delegating to independent agencies in a wide range of policy areas, ranging from monetary policy to judicial dispute resolution to securities regulation. This paper is an attempt to

³² Classification of outliers was based on *dfbeta* values calculated for each coefficient in our regressions. This is an appropriate indicator to the extent we are concerned that individual observations may have very large effects on our coefficient estimates. Observations with an absolute value of the *dfbeta* > 2/sqrt(N) were excluded. This involved the *dfbetas* relevant to the interaction terms (when one was present) and to governor turnover (for the inflation regressions in Table III).

³³ Coefficients and standard errors for the interaction terms in the *checks* and *executive constraints* regressions were -0.66 (0.44) and -0.5 (0.06).

³⁴ The exception here was the regression with *log check* where the coefficient on the *CBI x log check* interaction term lost some significance (*p*=0.36).

advance our understanding of the role of delegation by deepening the political arguments surrounding central bank independence and testing them on a broad and disparate set of countries. We introduce theory and evidence to make several points. First, depending on institutional and political details – the nature of agenda setting and the extent of political polarization – checks and balances are likely to reduce inflation expectations relative to countries that lack such institutions. Second, the delegation of decision making to agencies can only improve policy outcomes when checks and balances are a feature of a country's political system. Third, the impact of delegation depends, in turn, on political polarization and the structure of agenda setting.

The evidence for these points is direct: central banks are associated with better inflation outcomes in the presence of checks and balances. It is also indirect: the turnover of central bank governors is reduced when governors have tenure protections supported by political checks and balances; the impact of checks and balances is low when polarization is low; and checks and balances make the biggest contribution to central bank effectiveness in more polarized societies.

These results suggest that policy reformers face frustration if, in the absence of appropriate political institutions, they grant policy making authority to formally independent agencies. It is undeniable that these institutions, such as courts or central banks, can sometimes achieve a high level of prestige and respect such that citizens are willing to turn out governments that abridge their independence. However, at least in the case of central banks, the evidence suggests that prestige alone is insufficient to guarantee

³⁵ The coefficient on the interaction term in the low polarization sub-sample was -6.84 (2.85) while the

independence. Political institutions, instead, are crucial to the sustainability and effectiveness of decision making by independent agencies.

coefficient in the high polarization sub-sample was -5.16 (3.05).

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Annex 1: The *checks* and *political polarization* measures

Both *checks* and *political polarization* are taken from the Database of Political Institutions (Beck, et al.). In the DPI, *checks* is called Check2, and *political polarization* is called Polariz2.

For presidential systems, *checks* is the sum of 1 for the president and 1 for each legislative chamber. The value is increased by 1 if an electoral competition index developed by Bates, Ferree, and Singh is greater than 4 (out of a possible 7). Also, in closed list systems where the president's party is the 1st government party, the legislature is not counted. For parliamentary systems, *checks* is the sum of 1 for the prime minister and 1 for each party in the governing coalition. If elections are based on a closed list system and the prime minister's party is the 1st government party, then this sum is reduced by one. As for presidential systems, the value of *checks* is modified upwards by 1 if the value of the index for electoral competition is greater than 4.

The construction of political polarization begins with the assignment of values to the orientation measures (Left=-1, Center=0, Right=1). In presidential systems, if the president's party has an absolute majority in the legislature, then polarization is set equal to zero. If not, polarization is the maximum difference between the president's party's orientation and the weighted average of the orientations of the three largest government parties and the largest opposition party. For parliamentary systems, if the prime minister's party has an absolute majority in the legislature, polarization is again zero. If not, the value is the maximum difference between the values of the three largest government parties.

Annex 2: Derivation of expected inflation under checks and balances

Private actors solve for expected inflation using equation (10),

$$\pi^e = q_1 \left[\frac{b_E(\pi^e - \hat{\varepsilon}_1 + y^*)}{1 + b_E} \right] + q_2 \pi^e + q_3 \left[\frac{2b_L(\pi^e - \hat{\varepsilon}_3 + y^*)}{1 + b_L} - \pi^e \right] + q_4 \left[\frac{b_E(\pi^e - \hat{\varepsilon}_4 + y^*)}{1 + b_E} \right],$$

where the q_i 's are the probabilities of each of the four decision making outcomes and sum to one, and the $\hat{\varepsilon}_i$ are the expected values of the range of economic shocks over which these four possible outcomes can occur.

The probability q_1 , describes the likelihood that the shock will be such

that $\pi^e < \pi_E < \pi_L$. That is, $q_1 = \text{pr} \left[\pi^e < \frac{b_E}{1 + b_E} (y^* - \varepsilon + \pi^e) \right]$ or

$$(A.1) \quad q_1 = \text{pr} \left[\varepsilon < -\frac{1}{b_E} \pi^e + y^* \right].$$

Similarly, q_2 is the probability that $\pi_E < \pi^e < \pi_L$ or

$$(A.2) \quad q_2 = \text{pr} \left[-\frac{1}{b_L} \pi^e + y^* > \varepsilon > -\frac{1}{b_E} \pi^e + y^* \right].$$

q_3 is $\text{pr}[\pi_L < \pi^e < 2\pi_L - \pi_E]$, or

$$(A.3) \quad q_3 = \text{pr} \left[-\frac{1}{b_L} \pi^e + y^* < \varepsilon < \pi^e + y^* - \frac{(1 + b_E)(1 + b_L)}{(1 + b_E)2b_L - (1 + b_L)b_E} \pi^e \right]$$

and q_4 is $\text{pr}[\pi_L < 2\pi_L - \pi_E < \pi^e]$, or

$$(A.4) \quad q_4 = \text{pr} \left[\varepsilon > \pi^e + y^* - \frac{(1 + b_E)(1 + b_L)}{(1 + b_E)2b_L - (1 + b_L)b_E} \pi^e \right]$$

$$\text{Set } K = \frac{(1 + b_E)(1 + b_L)}{(1 + b_E)2b_L - (1 + b_L)b_E}$$

In order to fix the value of inflation that they expect, the private actors solve for the q_i 's and $\hat{\varepsilon}_i$'s in terms of the parameters and expected inflation. They then substitute the resulting terms into equation (10) and solve for expected inflation in terms of desired output and the preference parameters b_i . To carry out this exercise, assume ε is distributed uniformly over the range $[-c, c]$. Given this uniform distribution, (A.1) can be rewritten as

$$(A.4) \quad q_1 = \int_c^{\frac{1}{b_E}\pi^e + y^*} \frac{1}{2c} d\varepsilon = \frac{1}{2c} \left(-\frac{1}{b_E}\pi^e + y^* + c \right)$$

The average value of the shock over this range, $\hat{\varepsilon}_1$, is therefore

$$(A.5) \quad \hat{\varepsilon}_1 = \frac{1}{2} \left(-\frac{1}{b_E}\pi^e + y^* - c \right)$$

Proceeding in a parallel fashion with the remaining probabilities,

$$(A.6) \quad q_2 = \frac{1}{2c} \pi^e \left(\frac{1}{b_E} - \frac{1}{b_L} \right).$$

$$(A.7) \quad \hat{\varepsilon}_2 = \frac{1}{2} \left[2y^* - \pi^e \left(\frac{1}{b_E} + \frac{1}{b_L} \right) \right]$$

$$(A.8) \quad q_3 = \frac{1}{2c} \pi^e \left(1 - K + \frac{1}{b_L} \right)$$

$$(A.9) \quad \hat{\varepsilon}_3 = \frac{1}{2} \left[2y^* + \pi^e \left(1 - K + \frac{1}{b_L} \right) \right]$$

$$(A.10) \quad q_4 = \frac{1}{2c} [\pi^e (K - 1) - y^* + c]$$

$$(A.11) \quad \hat{\varepsilon}_4 = \frac{1}{2} [c + y^* + \pi^e (1 - K)]$$

Substituting these expressions into equation (10) and manipulating, one obtains the following quadratic equation in π^e .

(A.12)

$$\begin{aligned} & (\pi^e)^2 \left[\frac{b_E}{(1+b_E)} \left(-\frac{1}{b_E} - \frac{1}{2b_E^2} + K - 1 + \frac{(K-1)^2}{2} \right) + \frac{1}{b_E} - \frac{1}{b_L} + \left(1 - K + \frac{1}{b_L} \right) \left(\frac{2b_L}{(1+b_L)} \left(1 - \frac{1}{2} \left(1 - K - \frac{1}{b_L} \right) \right) - 1 \right) \right] \\ & - \pi^e \left(\frac{2c}{1+b_E} \right) + \frac{b_E}{1+b_E} 2y^*c = 0 \end{aligned}$$

If $b_E > b_L$, a similar analysis can be performed. In this case, though, the probabilities q attached to the inflation outcomes in equation (10) are reversed:

$$q_1 = \text{pr} \left[\varepsilon > -\frac{1}{b_E} \pi^e + y^* \right], q_2 = \text{pr} \left[-\frac{1}{b_L} \pi^e + y^* < \varepsilon < -\frac{1}{b_E} \pi^e + y^* \right],$$

$$q_3 = \text{pr} \left[-\frac{1}{b_L} \pi^e + y^* > \varepsilon > (1-K)\pi^e + y^* \right], \text{ and } q_4 = \text{pr} [\varepsilon < (1-K)\pi^e + y^*]. \text{ Substituting}$$

these, and the corresponding values for $\hat{\varepsilon}_i$, into equation (10) and solving, yields the

following expression for expected inflation when the Executive is more inflation tolerant than the Legislature:

(A.13)

$$\begin{aligned} & (\pi^e)^2 \left[\frac{b_E}{(1+b_E)} \left(\frac{1}{b_E} + \frac{1}{2b_E^2} + 1 - K + \frac{(1-K)^2}{2} \right) + \frac{1}{b_L} - \frac{1}{b_E} + \left(K - 1 - \frac{1}{b_L} \right) \left(\frac{2b_L}{(1+b_L)} \left(1 - \frac{1}{2} \left(1 - K - \frac{1}{b_L} \right) \right) - 1 \right) \right] \\ & - \pi^e \left(\frac{2c}{1+b_E} \right) + \frac{b_E}{1+b_E} 2y^*c = 0 \end{aligned}$$

Annex 3: Derivation of expected inflation under checks and balances with an independent central bank

From equation (13), for $b_E < b_L$, expected inflation is given by

$$\pi_{CB}^e = q_1 \left[\frac{b_E(\pi_{CB}^e - \hat{\varepsilon}_1 + y^*)}{1 + b_E} \right] + q_2 \left[\frac{2b_E(\pi_{CB}^e - \hat{\varepsilon}_2 + y^*)}{1 + b_E} - \pi_{CB}^e \right] + q_3 \left[2(\pi_{CB}^e - \hat{\varepsilon}_3 + y^*) \left(\frac{b_E}{1 + b_E} - \frac{b_L}{1 + b_L} \right) + \pi_{CB}^e \right] + q_4 \left[\frac{b_E(\pi_{CB}^e - \hat{\varepsilon}_4 + y^*)}{1 + b_E} \right].$$

If they override the central bank's proposal after the shock is revealed and the private actors have set expected inflation, the political actors make their determination of a new inflation policy exactly as if there were no central bank. The probabilities q_i and the expected shocks $\hat{\varepsilon}_i$ are calculated over the same limits as in the corresponding case in Annex 2 ($b_E < b_L$), with no central bank.

As in Annex 2, substituting the expressions for the probabilities and expected shocks into equation (13) and manipulating, we obtain the following expression for expected inflation under central bank independence and checks and balances:

$$\begin{aligned} (A.14) \quad (\pi_{CB}^e)^2 & \left[\frac{b_E}{1 + b_E} \left(-\frac{1}{b_E} - \frac{1}{2b_E^2} + K - 1 + \frac{(K-1)^2}{2} \right) + \frac{2b_E}{1 + b_E} \left(\frac{1}{b_E} - \frac{1}{b_L} \right) \left(1 + \frac{1}{2} \left(\frac{1}{b_E} + \frac{1}{b_L} \right) \right) - \frac{1}{b_E} + \frac{1}{b_L} \right. \\ & + \left. \left(1 - K + \frac{1}{b_L} \right) \left(\left(\frac{2b_E}{1 + b_E} - \frac{2b_L}{1 + b_L} \right) \left(1 - \frac{1}{2} \left(1 - K - \frac{1}{b_L} \right) \right) + 1 \right) \right] + \pi_{CB}^e \left[-\frac{2c}{(1 + b_E)} \right] \\ & + \frac{b_E}{1 + b_E} (2cy^*) = 0. \end{aligned}$$

Since the central bank conditions its policy choice on the preferences of the most inflation-averse political decision maker, the case where $b_E > b_L$ changes the payoffs that generated A.14. In particular, instead of choosing policies such that the Executive is just

indifferent between what the central bank proposes and what would prevail if the central bank decision were overridden and the checks and balances outcome (π_{CH}) prevailed, $\pi = 2\pi_E - \pi_{CH}$, the central bank instead proposes $\pi = 2\pi_L - \pi_{CH}$, such that the Legislature is just indifferent. Expected inflation is therefore the solution to

$$\pi_{CB}^e = q_1 \left[\left(\frac{2b_L}{1+b_L} - \frac{b_E}{1+b_E} \right) (\pi_{CB}^e - \hat{\varepsilon}_1 + y^*) \right] + q_2 \left[\frac{2b_L(\pi_{CB}^e - \hat{\varepsilon}_2 + y^*)}{1+b_L} - \pi_{CB}^e \right] + q_3 \pi_{CB}^e + q_4 \left[\left(\frac{2b_L}{1+b_L} - \frac{b_E}{1+b_E} \right) (\pi_{CB}^e - \hat{\varepsilon}_4 + y^*) \right].$$

The probabilities q_i and the expected shocks $\hat{\varepsilon}_i$ are calculated over the same limits as in the corresponding case ($b_E > b_L$) in Annex 2. Solving, we get the following solution for expected inflation:

$$(A.15) \quad (\pi_{CB}^e)^2 \left[\left(\frac{2b_L}{1+b_L} - \frac{b_E}{1+b_E} \right) \left(\frac{1}{b_E} + \frac{1}{2b_E^2} + 1 - K - \frac{(1-K)^2}{2} \right) + \frac{2b_L}{1+b_L} \left(\frac{1}{b_L} - \frac{1}{b_E} \right) \left(1 + \frac{1}{2} \left(\frac{1}{b_E} + \frac{1}{b_L} \right) \right) \right. \\ \left. - \frac{1}{b_L} + \frac{1}{b_E} + K - 1 - \frac{1}{b_L} \right] + 2c\pi_{CB}^e \left[-1 + \left(\frac{2b_L}{1+b_L} - \frac{b_E}{1+b_E} \right) \right] + \left(\frac{2b_L}{1+b_L} - \frac{b_E}{1+b_E} \right) 2cy^* = 0.$$

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